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TWO PATROL CAR DEPLOYMENT MODELS: HISTORY OF USE 1975-1979,(U)
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TWO PATROL CAR DEPLOYMENT MODELS: HISTORY OF USE 1975-1979

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(11) March 1980

(14) RAND/P-6458

P-6458

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In 1975, Rand made available two computer programs for analyzing deployment of police patrol cars: the Patrol Car Allocation Model (PCAM)[1,2,3] and the Hypercube Model.[4,5,6] PCAM is used primarily to determine the total number of patrol cars a department needs and how they should be allocated over days of the week, hours of the day, and geography. The Hypercube Model is used primarily for designing patrol beats (the areas covered by one car).

Both of these models were specifically designed to serve the needs of local police agencies with little or no outside technical assistance. The documentation for each includes a nontechnical *executive summary* that explains the kinds of applications for which the model is suitable, a *user's manual* that describes step-by-step how to operate the computer program once it is installed on a computer system, and a *program description* that provides information for data-processing personnel to install the model, construct a data base, and modify the model if needed. When the models were new, the designers undertook several field tests in which they worked closely with police agencies to refine both the models and the methods of applying them. However, after publication of the documentation in 1975, Rand assistance to users has been limited. The designers have provided copies of the computer programs, fixed a few errors in the programs, responded to user inquiries, and provided advice to organizations that included the models in their training program.

Early Implementation History

A 1977 survey[7] showed that 28 police departments had received PCAM, of which at least 15 were using it; 39 agencies had received the Hypercube Model, and 20 were using it. In 1978-79, approximately 18 additional police departments received the PCAM program.† Current PCAM users include San Diego (both police and sheriff), Atlanta, New York City, Portland (Oregon), Sacramento, Tucson, Los Angeles (both police and sheriff), and Charlotte.

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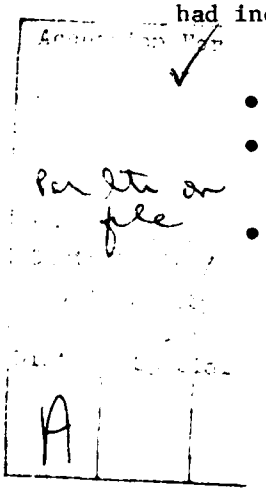
*The Hypercube Model was programmed at the Massachusetts Institute of Technology, partly under a HUD grant to Rand and partly under an NSF grant to MIT.

†Current information on Hypercube users has not been assembled. See appendix for a list of recipients of the Patrol Car Allocation Model.

Many examples of successful results from using these models have been written up by either the researchers involved or the police department planners. In Arlington, Massachusetts,[8] new patrol sectors were designed with the Hypercube Model and implemented in 1975. In Quincy, Massachusetts,[9] the number of cars on duty and their patrol beats were changed after a comprehensive Hypercube study. The National Science Foundation conducted a field evaluation of the Hypercube system[10] during 1976-77. One of the case study cities in that evaluation, Fresno, California, completely modified an antiquated beat configuration that involved the same total number of patrol beats around the clock, every day. The new plan reallocated manpower by shift and realigned beat boundaries. The impact of the changes was judged favorable by the evaluators because the following improvements occurred:

- Calls for service held by dispatchers decreased.
- Average travel time to calls decreased.
- Manpower reallocation eliminated a previously assumed need to increase the number of police personnel.[11]

In Wilmington, Delaware,[12] PCAM and Hypercube were used together to design an innovative split-force concept that the evaluators showed had increased the efficiency of the patrol force by:



- Reallocating manpower by times of day.
- Establishing a priority system for calls for service and allowing low-priority calls to be delayed or dropped.
- Splitting the patrol force into two groups, only one of which had primary responsibility for handling calls for service. The other group was assigned to carry out proactive anticrime activities. Because the proactive patrol force was freed from the constant interruption of calls for service, it was able to engage in more intensive and productive actions.

Later Developments: Improving and Institutionalizing the Process

In San Diego, the city's Financial Management Department used PCAM in an overall evaluation of the Police Bureau's productivity, calling

the program a "highly important and innovative tool" for specifying manpower requirements related to response times and proactive patrol.[13] The evaluation led not only to revised manpower allocations but also to a procedure for updating the analysis each year.

In Atlanta and Seattle as well, use of PCAM has become a routine part of the budget process. An article on the Seattle experience[14] summed up:

> Since the spring of 1975, the PCAM program has been used several times to model response delay characteristics under hypothetical patrol car levels. Specifically, it was used for both the 1977 and 1978 Patrol Bureau budget preparations.

An application of PCAM in the Los Angeles Sheriff's Department was assisted by behavior science change theorists who devised special techniques for gaining acceptance of the use of computer programs and their output.[15] Included was a before-and-after survey of the attitudes of patrol officers, dispatchers, and other police employees affected by new allocations. The changed manpower allocations that arose from using the model were well accepted not only because they appeared to be justified but also because the new deployment was "based on a common objective method for all stations." In Columbus, Ohio, the output from PCAM was tied into a goal programming methodology that permits assigning different weights to the various performance measures and arriving at optimal compromise solutions.[16]

The Fort Wayne Police Department developed a graphical method for displaying PCAM's output to show "improvements, advantages, and disadvantages of various manpower combinations."[17] The graphs are used to match overall manpower resources with the community's needs and demands.

Planning for More Widespread Future Use

Based partially on these experiences of individual departments and the results of a national study on improving patrol productivity,[18] the National Institute of Law Enforcement and Criminal Justice developed a program called Managing Patrol Operations (MPO)[19] and funded a field test in three cities: Albuquerque, Charlotte, and Sacramento. The

field test is being evaluated by the Theorem Institute.[20] A *required* component of the MPO program is that each participating department must use PCAM to revise its priority system for calls for service, its patrol resources, and its allocation of those resources. The Hypercube Model is an optional component of the MPO program, although some computerized method for evaluating beat designs must be undertaken by participating agencies.

The operational objectives of the MPO program are:

- To increase the efficiency of the calls for service response and thereby increase the portion of patrol resources devoted to what has traditionally been called random patrol;
- To replace random patrol with field service activities directed toward specific crime and service-oriented problems; and
- To develop the ability of police policy makers to define realistic patrol performance objectives and to formulate allocation strategies that service those objectives.[21]

The evaluation is examining specifically the usefulness of the computer models, including the ease or difficulty of preparing data bases, the understandability and interpretation of output, the manner in which the output influences decisionmaking, their effect on manpower allocations, and compatibility among various models. Anticipated products of the evaluation include recommendations for improvements that should be made in the models before transfer to additional police agencies would be sponsored by the federal government.

FOOTNOTES

1. Jan M. Chaiken and Peter Dormont, Patrol Car Allocation Model: Executive Summary, The Rand Corporation, R-1786/1-HUD/DOJ, September 1975.

2. Jan M. Chaiken and Peter Dormont, Patrol Car Allocation Model: User's Manual, The Rand Corporation, R-1786/2-HUD/DOJ, September 1975.

3. Jan M. Chaiken and Peter Dormont, Patrol Car Allocation Model: Program Description, The Rand Corporation, R-1786/3-HUD/DOJ, September 1975.

4. Jan M. Chaiken, Hypercube Queuing Model: Executive Summary, The Rand Corporation, R-1688/1-HUD, July 1975.

5. Richard C. Larson, Hypercube Queuing Model: User's Manual, The Rand Corporation, R-1688/2-HUD, July 1975.

6. Richard C. Larson, Hypercube Queuing Model: Program Description, The Rand Corporation, R-1688/3-HUD, July 1975.

7. Jan M. Chaiken, "Transfer of Emergency Service Deployment Models to Operating Agencies," Management Science, Vol. 24, No. 7, March 1978, pp. 719-731.

8. James P. Jarvis and Mark A. McKnew, "Applying the Hypercube in Arlington, Massachusetts," Chapter 7 in Richard C. Larson (ed.), Police Deployment, Lexington Books, 1978.

9. Chief of Police Francis X. Finn et al., "Quincy Police Department: Application of the Hypercube Model Sector Design Analysis," Chapter 8 in Police Deployment, op. cit.

10. Nelson B. Heller et al., Field Evaluation of the Hypercube System for the Analysis of Police Patrol Operations: Final Report, The Institute for Public Program Analysis, St. Louis, Missouri, October 1977.

11. William W. Stenzel et al., Field Evaluation of the Hypercube System for the Analysis of Police Patrol Operations: Executive Summary, The Institute for Public Program Analysis, St. Louis, Missouri, October 1977, pp. 21-22.

12. James M. Tien et al., An Evaluation Report of an Alternative Approach in Police Patrol: The Wilmington Split-Force Experiment, Public Systems Evaluation, Cambridge, Massachusetts, March 1977.

13. Bob Lynn et al., Program Evaluation. Productivity Improvement Project: Police Patrol Bureau, Financial Management Department, City of San Diego, California, September 1978.

14. John S.Y. Chiu, "Police Patrol Budgeting by Statistical Forecasting and Computer Simulation," Journal of Contemporary Business, Vol. 8, August 1979, pp. 35-47.

15. William C. Bengtson et al., "Enhancing the Chances of Successful Implementation of a Management Science Method Through Change Theory: A Case Study in a Public Sector Organization," paper presented at the XXIV International Meeting of the Institute of Management Sciences, June 1979, Los Angeles County Sheriff's Department, Los Angeles, California.

16. Brooke Saladin, A Methodology for Allocating Police Patrol Units, Working Paper 79-056, College of Business Administration, The University of Georgia, June 1979.

17. Sgt. Thomas Rody, Jr., Graphical Appraisal of Allocating Manpower by PCAM, Fort Wayne, Indiana, Police Department, May 1978.

18. William G. Gay et al., Prescriptive Package: Improving Police Productivity, National Institute of Law Enforcement and Criminal Justice, U.S. Government Printing Office, July 1977.

19. Managing Patrol Operations: Program Test Design, National Institute of Law Enforcement and Criminal Justice, 1978.

20. Managing Patrol Operations: Evaluation Design, Theorem Institute, San Jose, California, May 1979.

21. Ibid., p. 2-2.

Appendix

RECIPIENTS OF PCAM PROGRAM

Type[a]	Location	Date
PD	Wilmington, Delaware	9/75
I	CompuServ Network	9/75
I	Jet Propulsion Laboratory	9/75
PD	Seattle, Washington	9/75
PD	Atlanta, Georgia	9/75
I	PRC/Public Management, Inc.	9/75
OG	Attorney General of British Columbia	9/75
PD	Toledo, Ohio	10/75
I	Texas A & M University	10/75
PD	The Netherlands Bureau of Police Automation	10/75
I	The Institute for Public Program Analysis (TIPPA)	10/75
PD	Edmonton, Alberta	11/75
PD	Newark, New Jersey	11/75
PD	Minneapolis, Minnesota	11/75
PD	New York City	12/75
SD	Jacksonville, Florida	1/76
PD	Virginia Beach, Virginia	2/76
SD	Los Angeles, California	2/76
I	Florida International University	5/76
PD	Los Angeles, California	6/76
PD	San Diego, California	7/76
PD	Baltimore County, Maryland	7/76
PD	Metropolitan District Police (Boston)	8/76
PD	Santa Ana, California	8/76
I	Ohio State University	8/76
PD	Kansas City, Missouri	8/76
PD	Beloit, Wisconsin	8/76
PD	Washington, D.C.	8/76
SD	Palm Beach County, Florida	9/76
PD	Arvada, Colorado	9/76
PD	Fort Wayne, Indiana	9/76
PD	Tucson, Arizona	12/76
PD	New Brunswick, New Jersey	12/76
PD	St. Louis County, Missouri	1/77
PD	Detroit, Michigan	2/77

[a]PD = police department; SD = sheriff's department; OG = other governmental unit; I = individual whose company or university is listed.

(continued)

Type[a]	Location	Date
OG	Winnipeg Fire Department	4/77
SD	San Diego	5/77
PD	Columbus, Ohio	7/77
I	International Association of Chiefs of Police	7/77
PD	Portland, Oregon	7/77
I	Decision Sciences, Inc.	7/77
OG	Bi-State Metropolitan Computer Commission (Davenport, Iowa)	9/77
PD	Tampa, Florida	9/77
PD	Shreveport, Louisiana	10/77
OG	Government of Israel	11/77
OG	Columbia, SC, Office of Criminal Justice Programs	2/78
I	Arizona State University	9/78
PD	Orlando, Florida	9/78
I	Wayne State University	9/78
PD	Santa Monica, California	9/78
PD	Lincoln, Nebraska	12/78
I	State University of New York at Buffalo	1/79
PD	Anchorage, Alaska	4/79
I	University of Michigan	5/79
PD	Prince Georges County, Maryland	6/79
PD	Honolulu, Hawaii	8/79
PD	Fairfax County, Virginia	1/80
PD	Grand Rapids, Michigan	2/80
	Field Test Cities (Managing Patrol Operations):	(Use PCAM on commercial timesharing service)
PD	Albuquerque, New Mexico	
PD	Charlotte, North Carolina	
PD	Sacramento, California	

[a]PD = police department; SD = sheriff's department; OG = other governmental unit; I = individual whose company or university is listed.